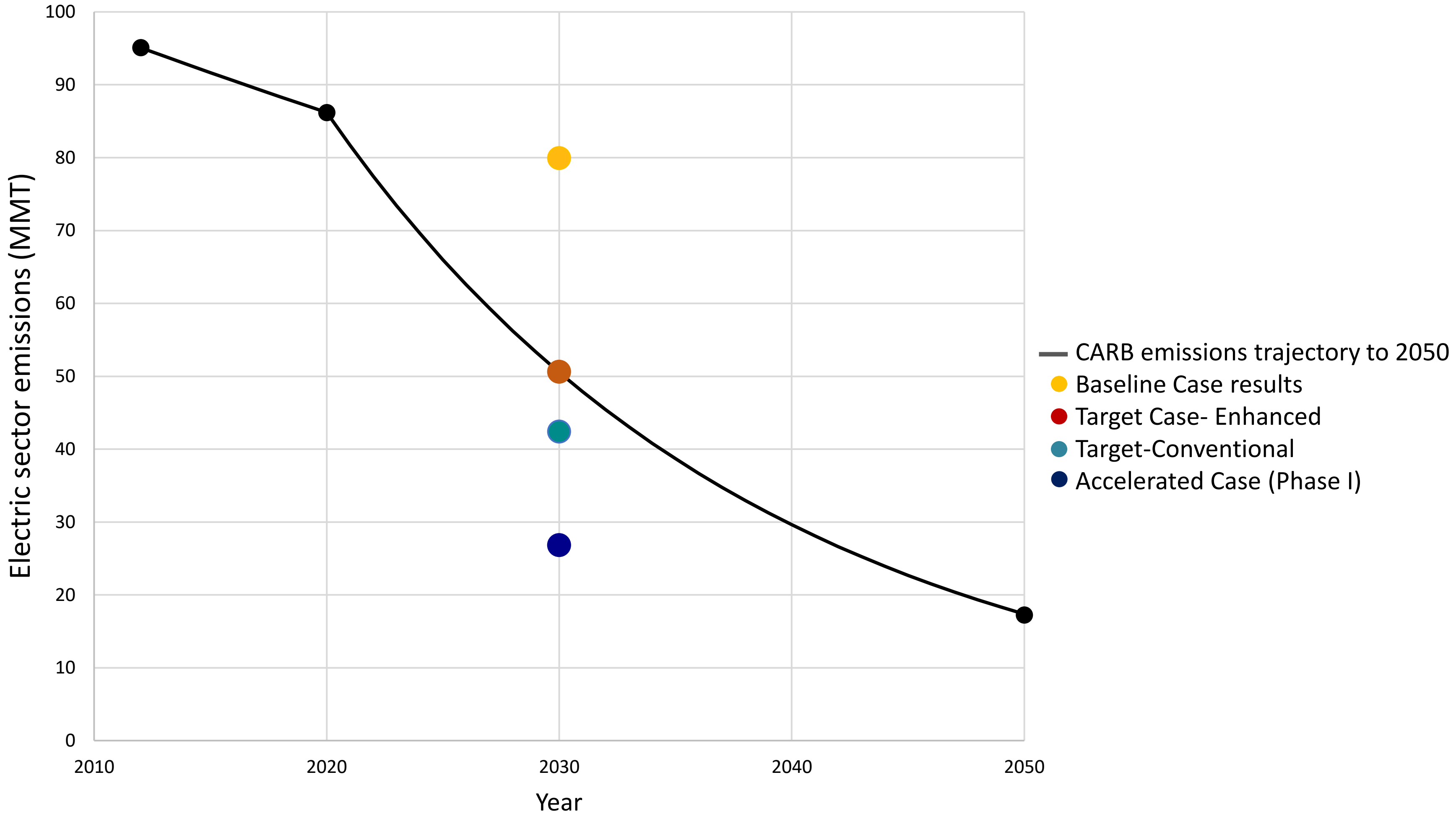
Low Carbon Grid Study

RETI 2.0 Workshop
Sacramento, CA
April, 2016

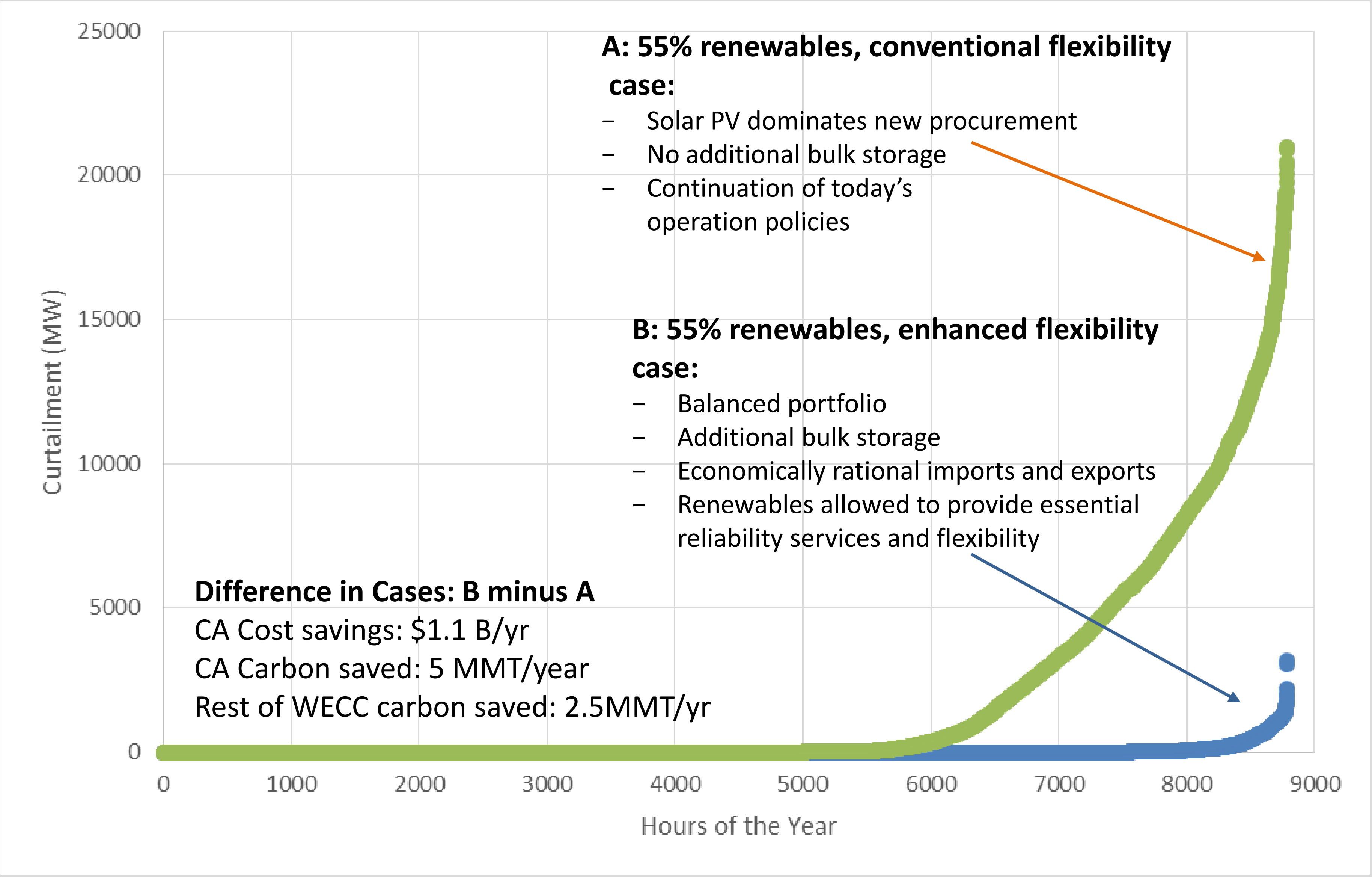
Low Carbon Grid Study

Carbon Emission Trajectories



Low Carbon Grid Study

Curtailment of Renewable Energy



A: 55% renewables, conventional flexibility case:

- Solar PV dominates new procurement
- No additional bulk storage
- Continuation of today's operation policies

B: 55% renewables, enhanced flexibility case:

- Balanced portfolio
- Additional bulk storage
- Economically rational imports and exports
- Renewables allowed to provide essential reliability services and flexibility

Difference in Cases: B minus A

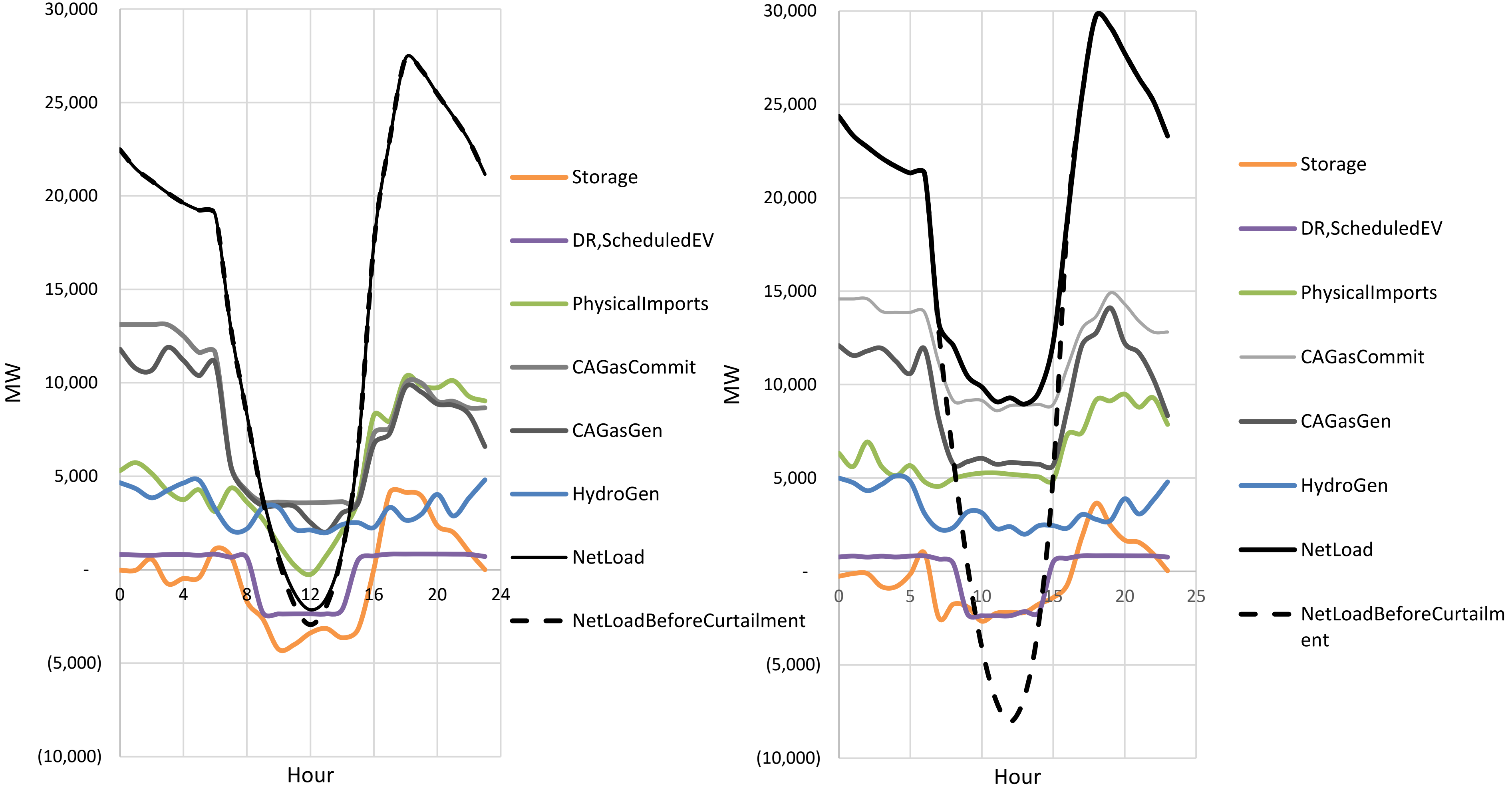
CA Cost savings: $1.1 B/yr

CA Carbon saved: 5 MMT/year

Rest of WECC carbon saved: 2.5MMT/yr

Low Carbon Grid Study

Steepest Ramp Day Dispatch (Winter)



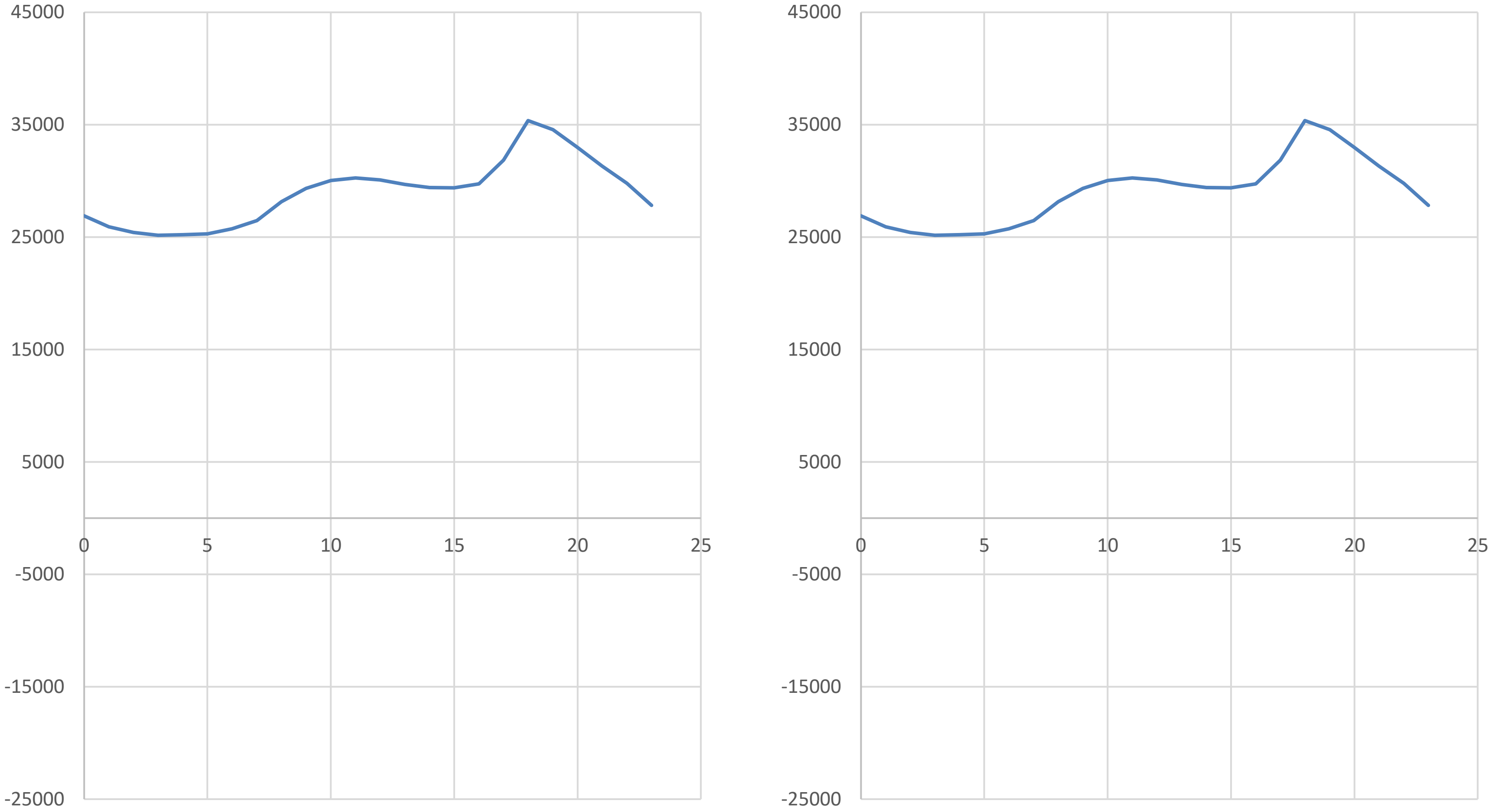
Feb 8th: Target- Enhanced

Feb 8th: High Solar- Conventional

Low Carbon Grid Study

Steepest Ramp Day Dispatch (Winter)

Load



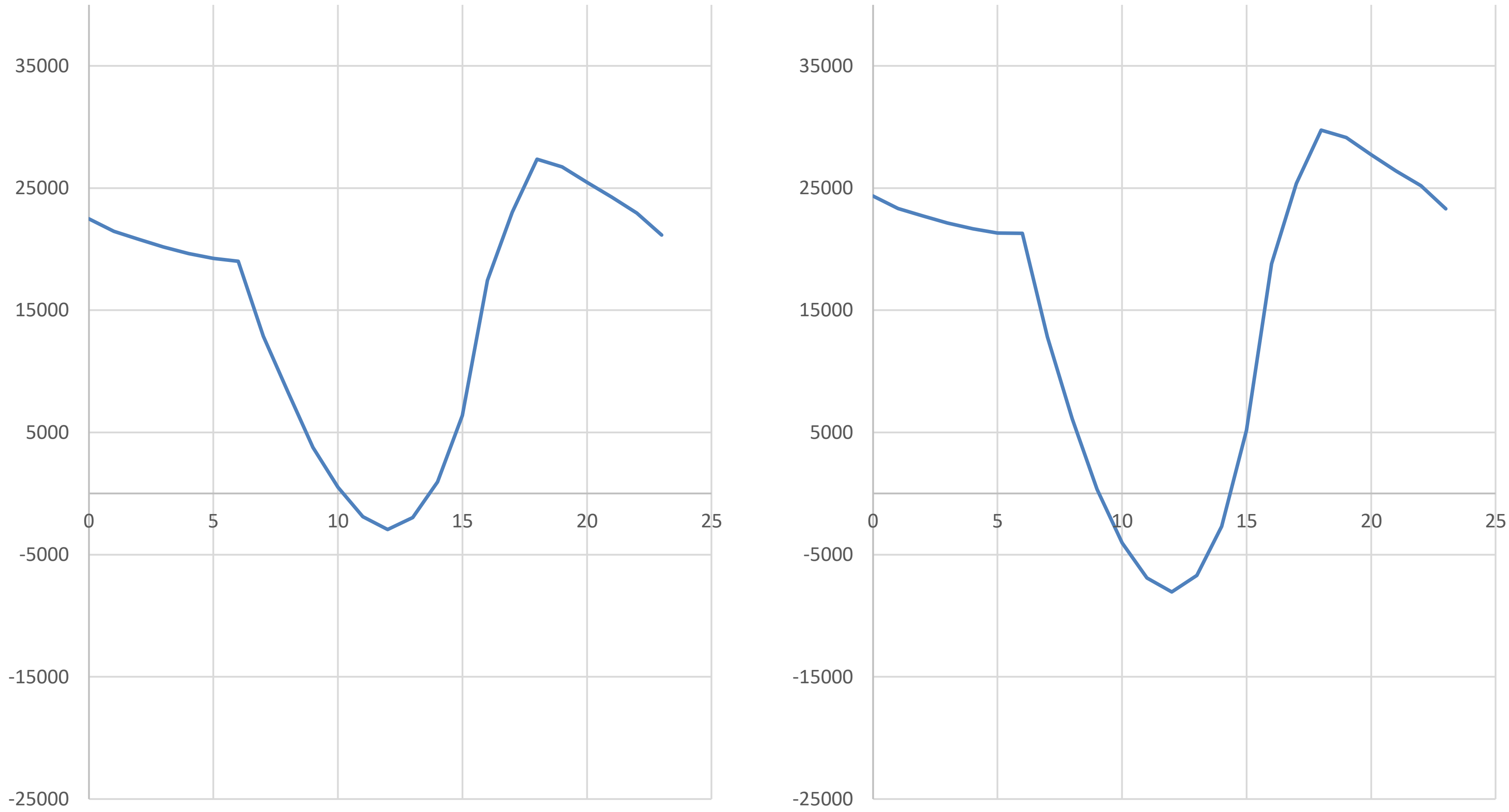
Target- Enhanced

High Solar- Conventional

Low Carbon Grid Study

Steepest Ramp Day (Winter)

Net Load: Load – Variable Gen



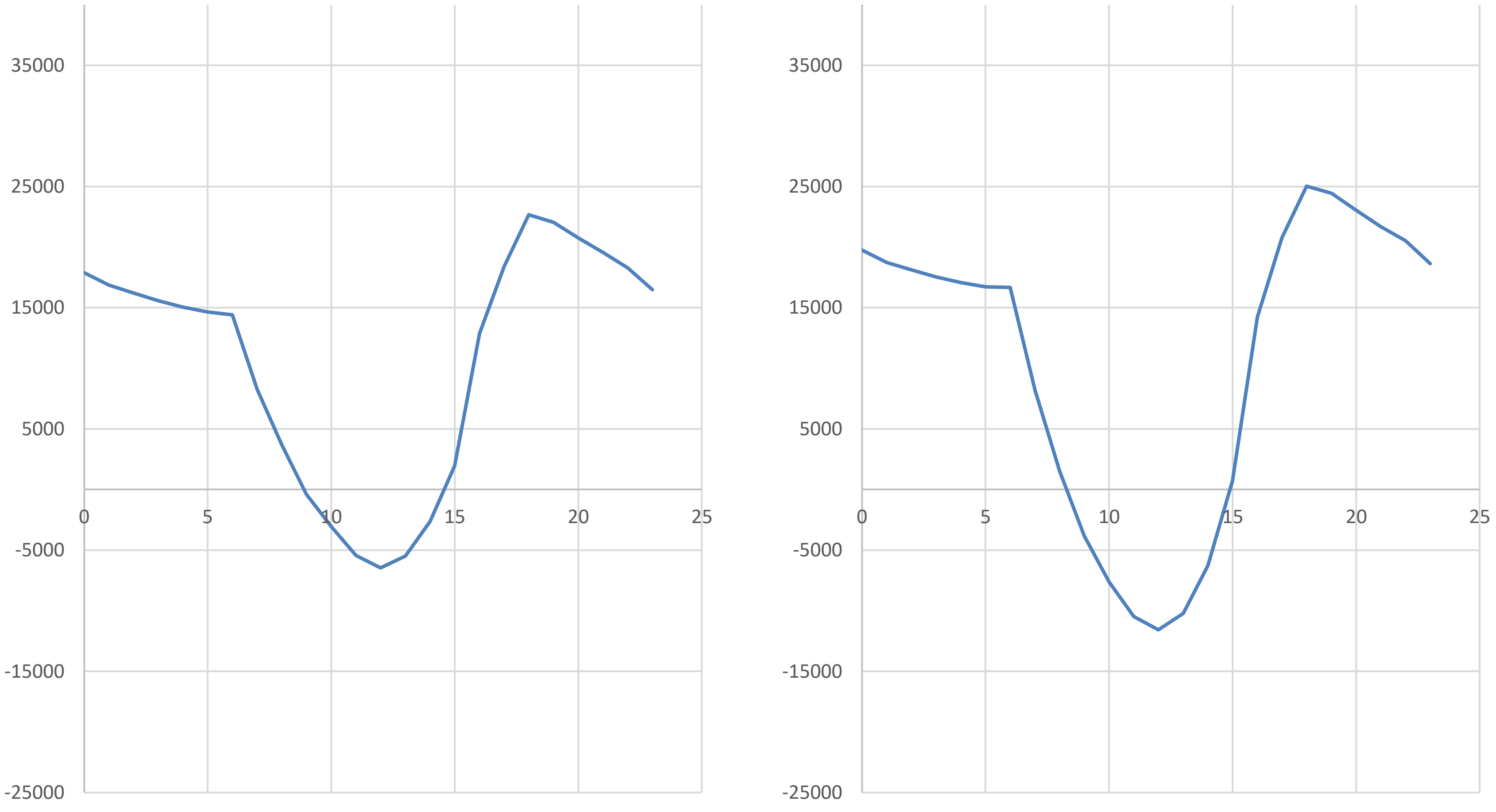
Target- Enhanced

High Solar- Conventional

Low Carbon Grid Study

Steepest Ramp Day (Winter)

Load – All Renewables



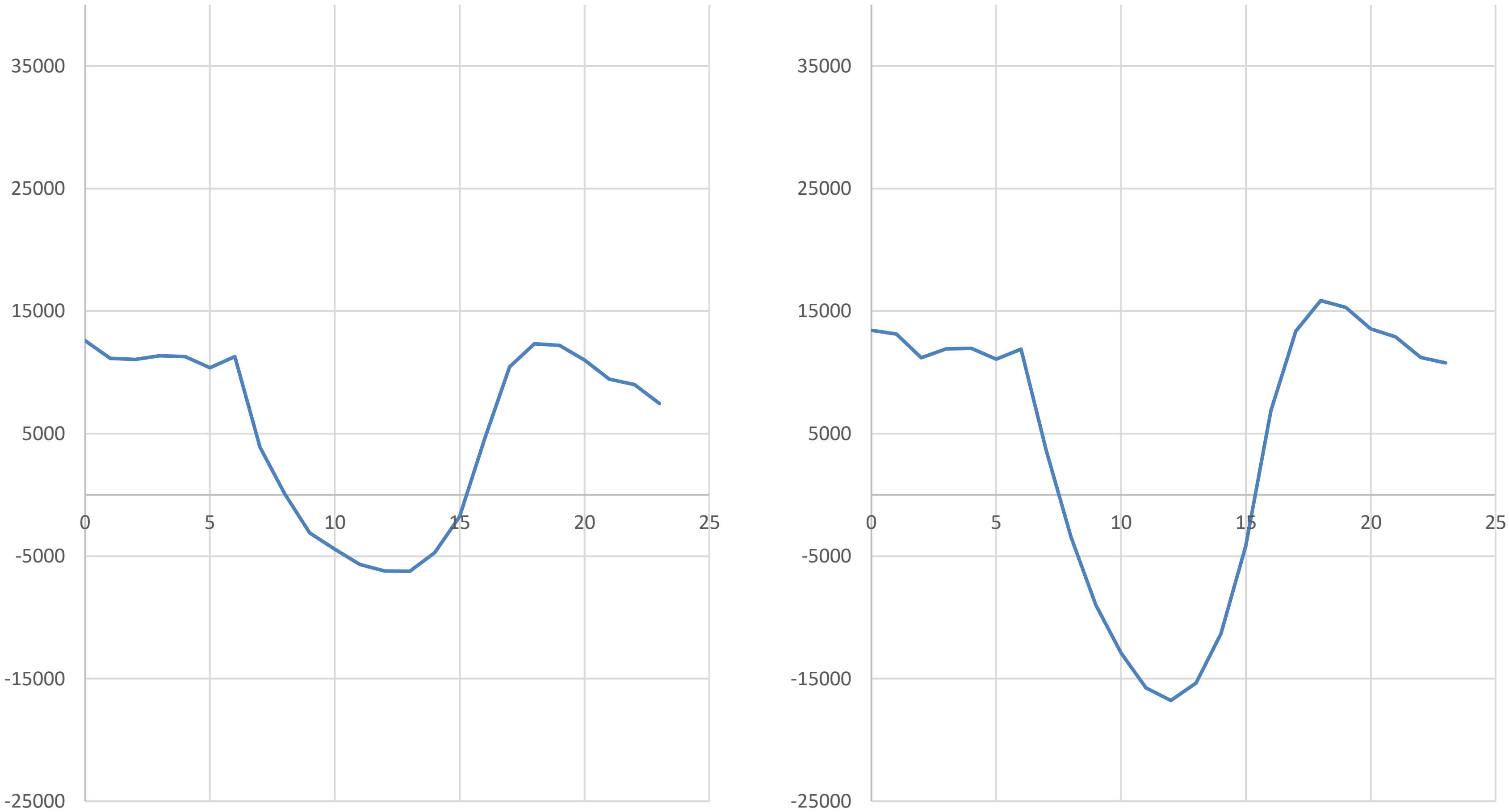
Target- Enhanced

High Solar- Conventional

Low Carbon Grid Study

Steepest Ramp Day (Winter)

Load – Renewables - Imports



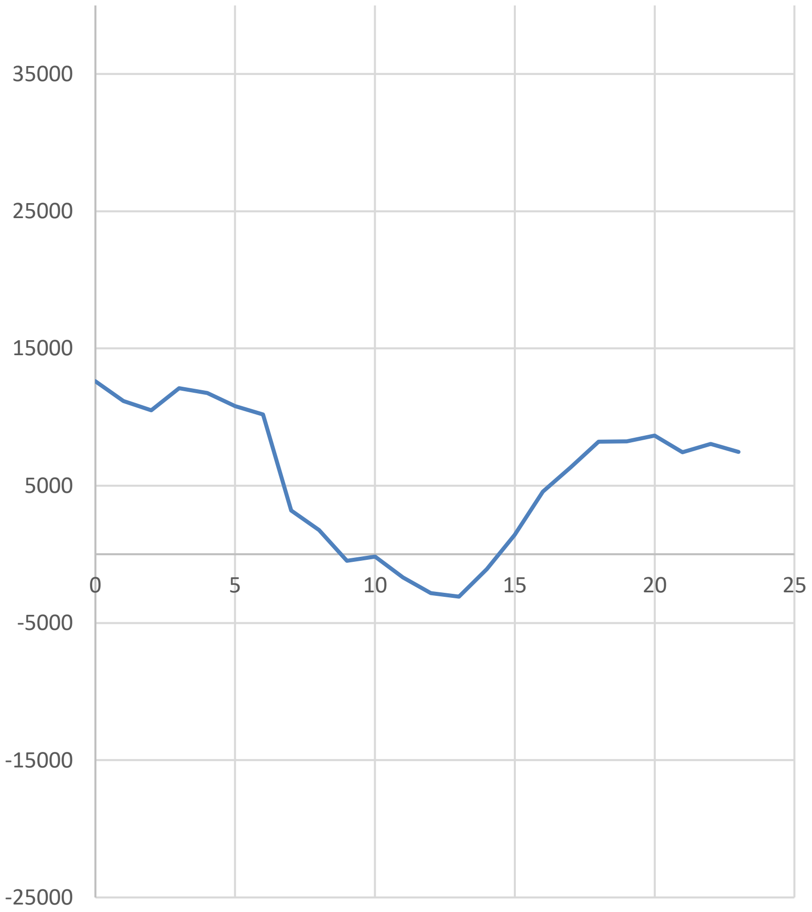
Target- Enhanced

High Solar- Conventional

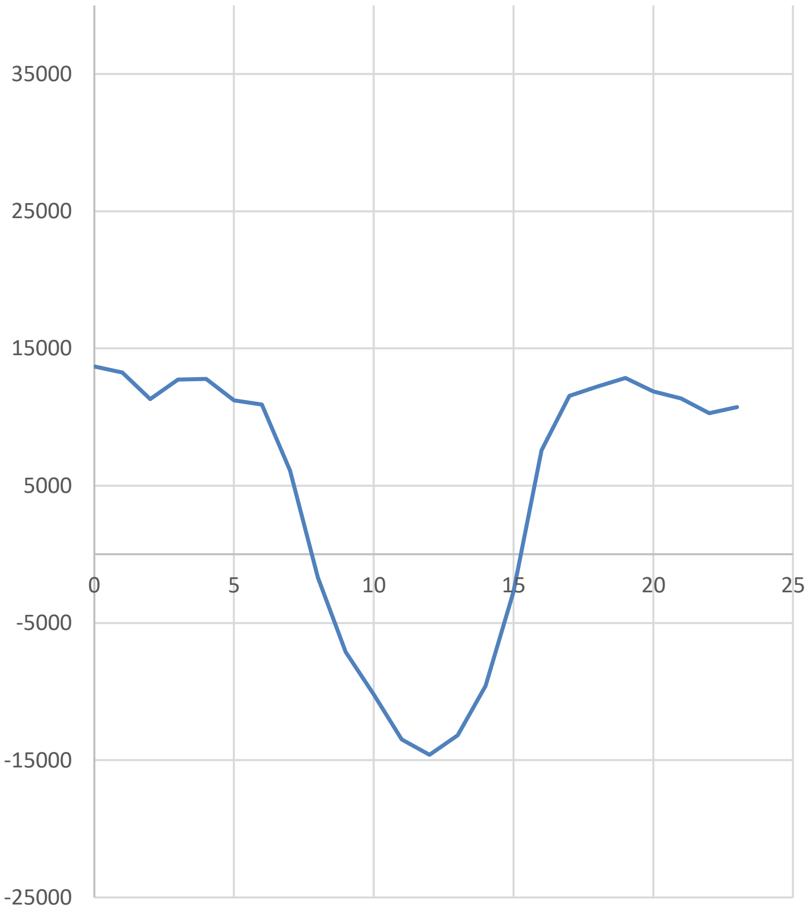
Low Carbon Grid Study

Steepest Ramp Day (Winter)

Load – Renewables – Imports – Storage



Target- Enhanced

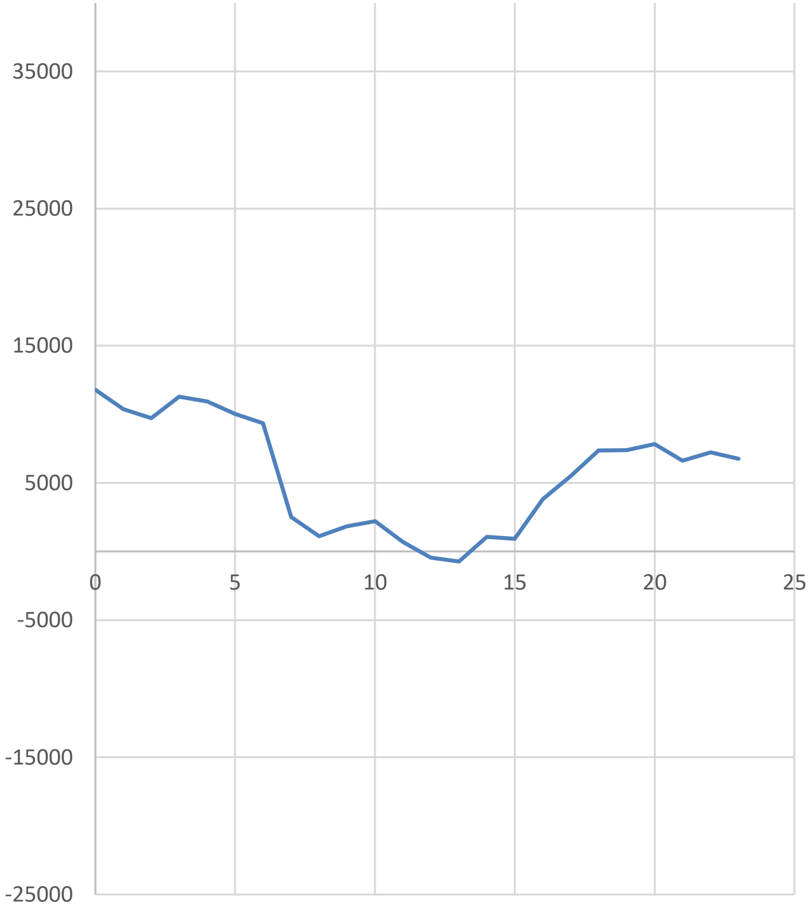


High Solar- Conventional

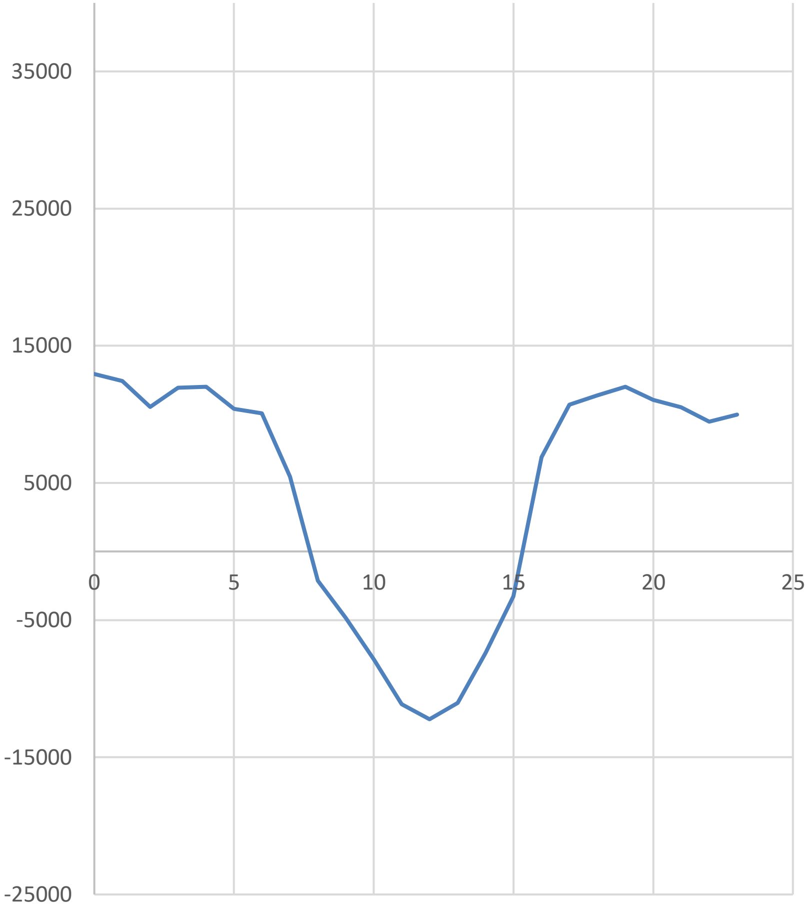
Low Carbon Grid Study

Steepest Ramp Day (Winter)

Load – Renewables – Imports – Storage – DR



Target- Enhanced

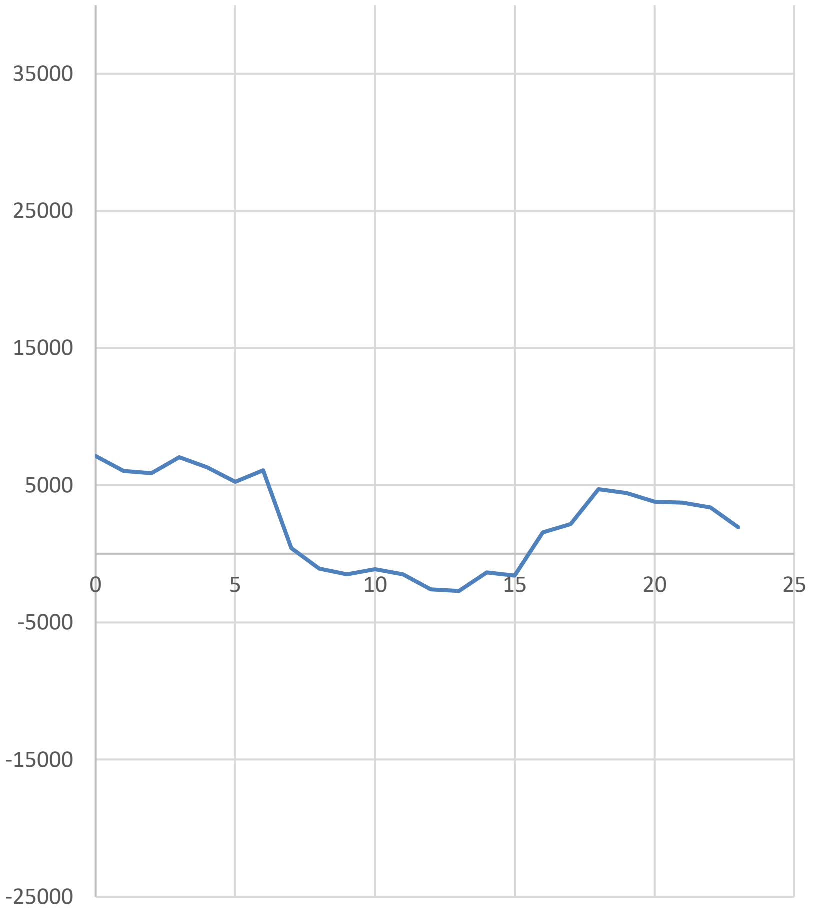


High Solar- Conventional

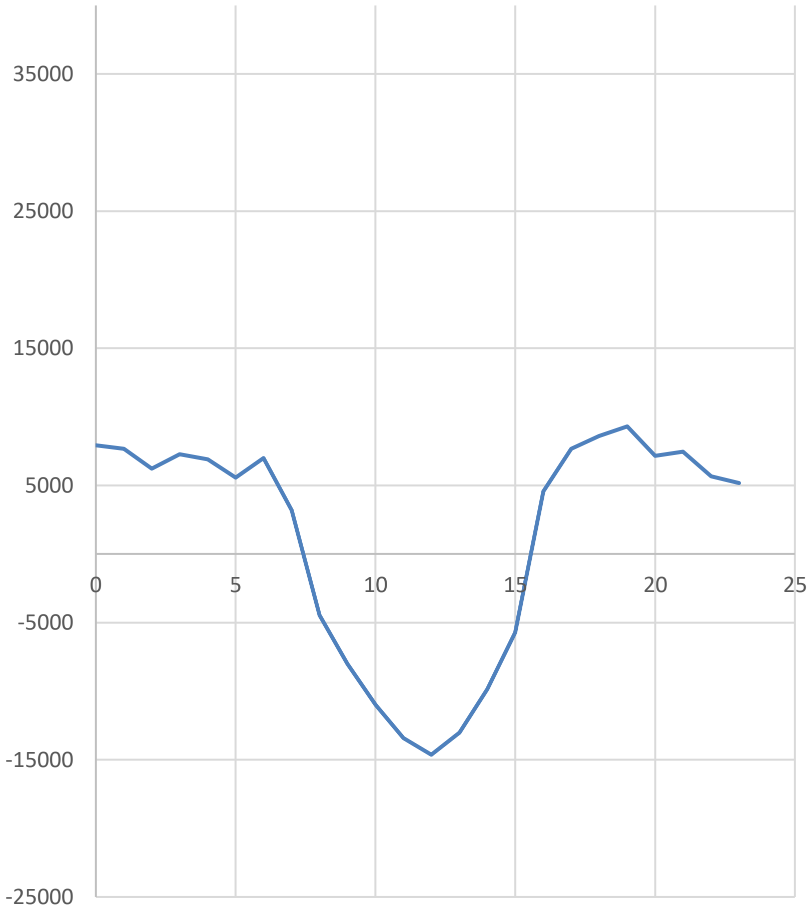
Low Carbon Grid Study

Steepest Ramp Day (Winter)

Load – Renewables – Imports – Storage – DR - Hydro



Target- Enhanced



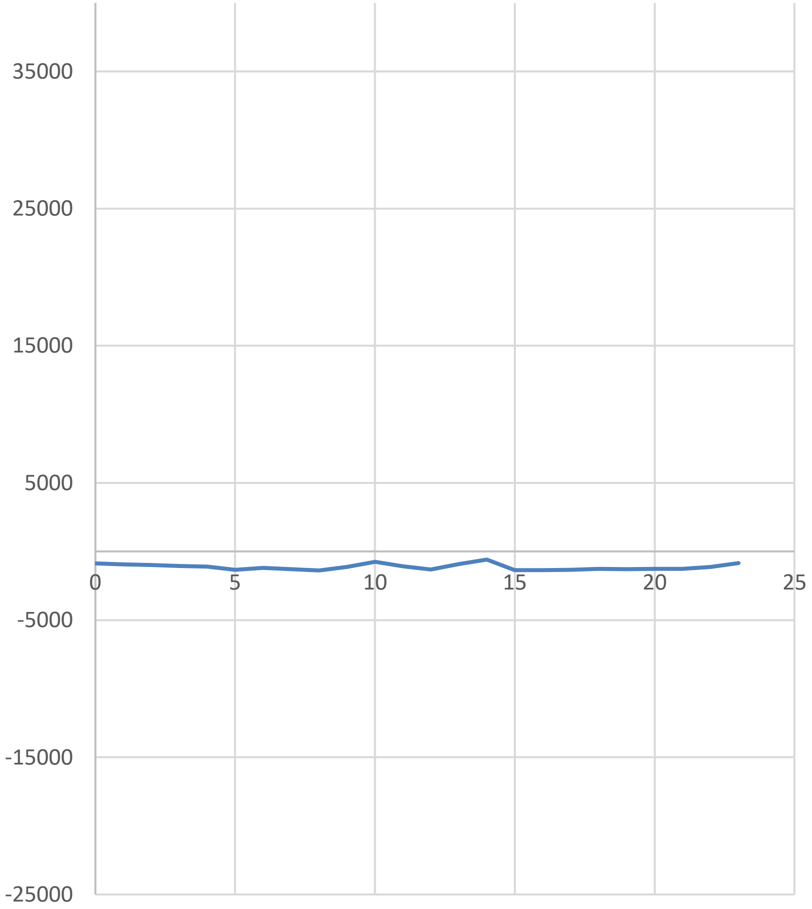
High Solar- Conventional

Low Carbon Grid Study

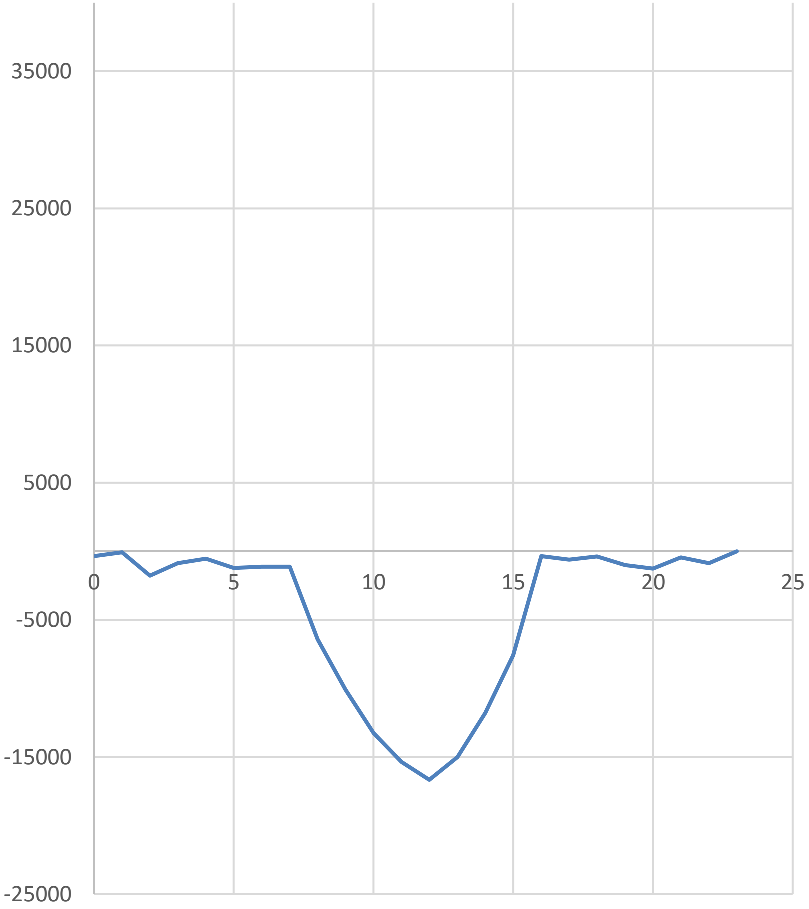
Steepest Ramp Day (Winter)

Curtailment:

Load – Renewables – Imports – Storage – DR – Hydro - Gas



Target- Enhanced



High Solar- Conventional

Low Carbon Grid Study

Principal Conclusions

I. Climate & Clean Energy Goals are Technically Feasible without significant rate impacts

- The California electric sector can reduce 40-50MM Tons/CO2 annually by 2030, a significant contribution to SB 350 target of 40% below 1990 GHG levels. On the trajectory to meet long term goal of 80% reduction.
- Meets or exceeds a 50-60% RPS
- Accommodates a 50% reduction in commercial and industrial energy use in buildings
- Absorbs the increased energy load from a projected 3.3 MM electric vehicles

II. Multiple Paths with Significantly Different Costs

- Conventional Flexibility measures present significant cost barriers to effective GHG reduction
- Enhanced Flexibility measures present low cost means to 2030 GHG reduction target as well as pathway to deeper reductions

III. Critical Components of Enhanced Flexibility

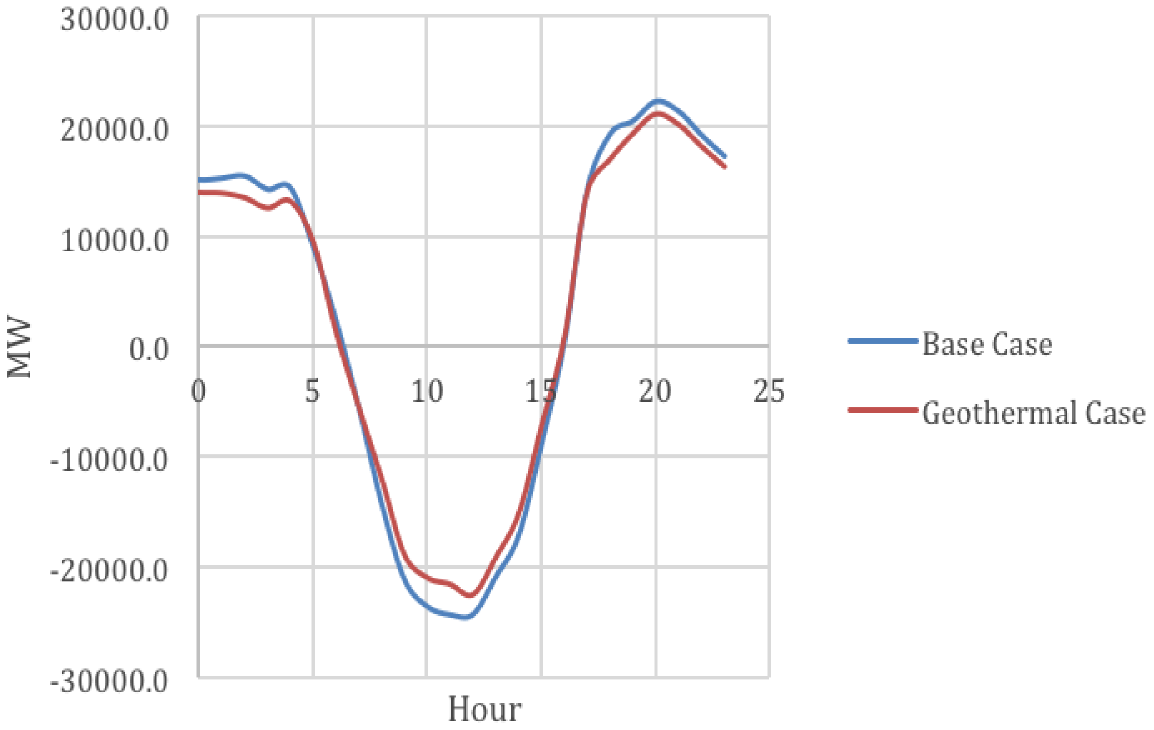
1) Real time carbon accounting for dispatch, unit commitment as well as procurement and planning
2) Technologically and geographically diverse renewable energy portfolio including: grid-scale PV solar, rooftop solar, regional wind, geothermal, biomass, and concentrating solar power with thermal storage
3) Bulk storage benefits shared across multiple balancing authorities and utilities, including both new projects and an optimized, statewide use of existing non-IOU pumped hydro
4) Essential reliability services provided by non-thermal resources
5) Strategic dispatch of natural gas resources, staggered quick starts to prevent idling, ramping
6) Increased flexibility in unbundled REC accounting without new legislation, enabling optimal sub-hourly dispatch

Low Carbon Grid Study
Value of a Diverse Portfolio

- Conducted additional modeling to isolate the importance of a diverse portfolio at 50+% RPS. Looked at the following changes to the "diverse portfolio" in the LCGS:
    - Removed 10 twh (1250 MW) of Salton Sea geothermal and replaced it with 10 twh (3800 MW) of utility scale solar PV.
    - Removed 19.5 twh (4475 MW) of Wyoming and New Mexico wind and replaced it with 19.5 twh (7625 MW) of CA utility scale solar PV.
- Results:
    - Salton Sea geothermal is more valuable than solar PV at the margin by as much as $75/MWH if the grid is not made more flexible, and $40/MWH, after adjusting for the cost of new storage, if the inherent flexibility in the grid is fully utilized.
    - The first large increment of Wyoming and New Mexico wind is net, net about $60/MWH more valuable than the last large increment of solar PV.
    - +/- 3% rate impacts are at stake.

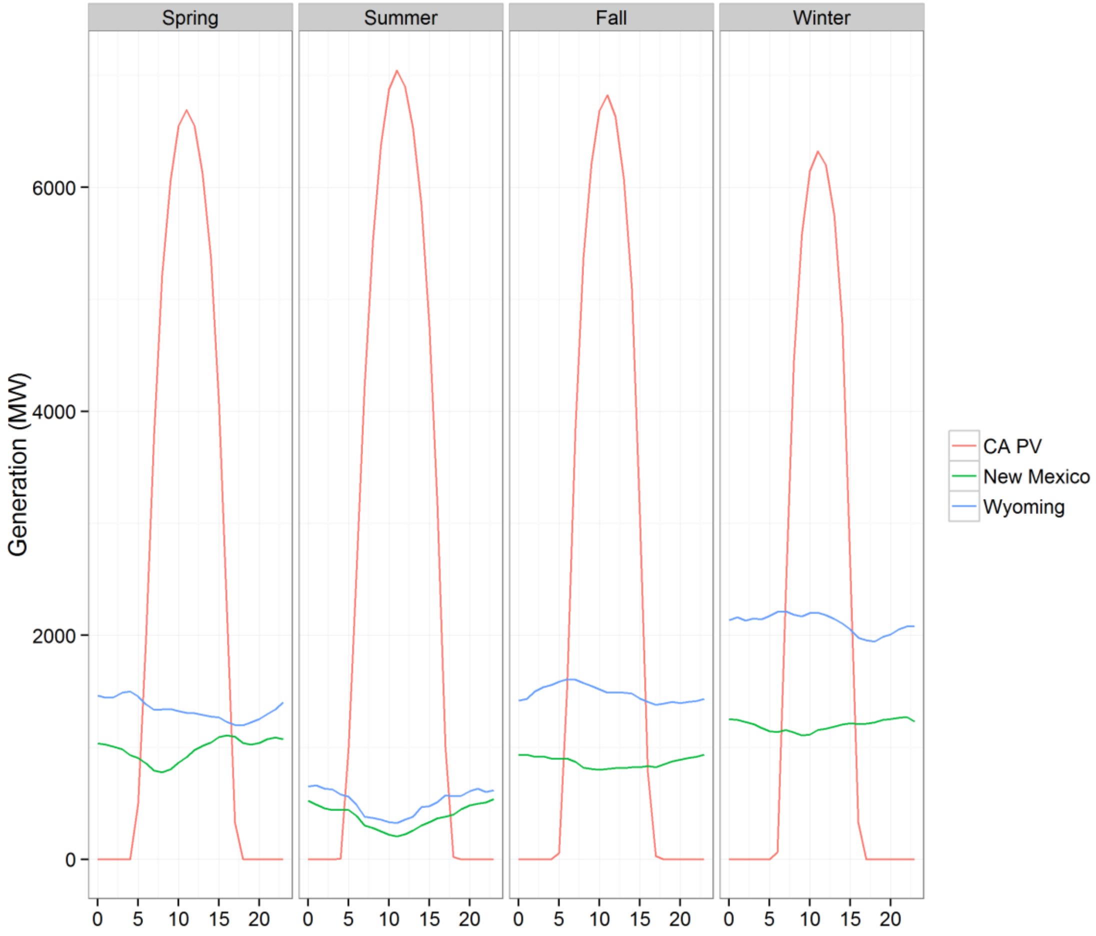
Low Carbon Grid Study

Impact of Baseload Geothermal on Net Load



Low Carbon Grid Study

Out of State Wind



Low Carbon Grid Study Recommendations

- The use of the RPS Calculator as the exclusive state resource planning tool, the concept of “durable” technology specific “integration cost adders,” the use of TOD multipliers based on historic load shapes for procurement, a reliance on LCOE as the principal metric for value, the CPUC/CEC /ARB decisions interpreting the Public Utility Code PCC rules and carbon accounting rules for imports – all of these need to be re-examined from scratch.

- Somehow, the Department of Water Resources hydro system must be integrated into the electric utility grid.

- Somehow, we must develop a robust, mutually beneficial trading pattern between and among CAISO, LADWP, BANC, IID and Turlock.

- Expansion of the CAISO into or towards a WECC wide RTO is a very important topic of discussion.

- Planning for retirement of Diablo Canyon, and the role of natural gas in the future electric grid are also critical issues.

Low Carbon Grid Study

Thank you!

www.lowcarbongrid2030.org